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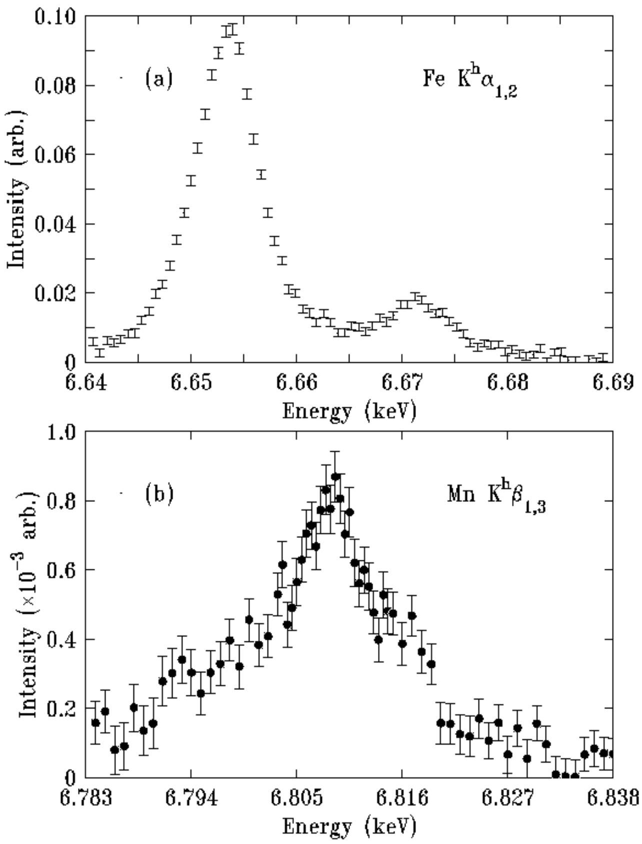
Names and affiliations of applicants (* indicates experimentalists):

*Moshe Deutsch, *Reut Diamant : Bar-Ilan University, Israel

*Keijo Hamalainen, *Simo Huotari : University of Helsinki, Finland

Chi-chang Kao, Brookhaven National Laboratory, U.S.A.

Report:



We have measured the Mn $K^h\beta_{1,3}$ hypersatellite spectrum high above the threshold, in the saturation limit. A preliminary background subtracted spectrum is shown in figure (b). The underlying, highly overlapping structure is clearly observed as "shoulders" on both sides of the peak. This is the first $K^h\beta_{1,3}$ hypersatellite line of any 3d transition metal measured with a resolution high enough to allow lineshape analysis. Such analysis, based on ab-initio relativistic Dirac-Fock calculations is currently in progress. An extremely low cross-section, two orders of magnitude below that of the $K^h\alpha_{1,2}$ hypersatellite, is found, where a factor of only ~12 was expected, based on the intensity ratio of the corresponding *diagram* lines. This reduction is due to the fact that the $K^h\beta_{1,3}$ lines lie *above* the Mn K edge, rendering the target's selfabsorption very high. The phenomenological characteristics (position and width) of the spectrum agree well with theoretical predictions and previous measurements. Finally, we have also measured the yield curve at the peak's position. The yield vs. incident energy has a saturation curve shape extending over several keV. It rises from zero, indicating a shake-off origin for the initial state, as indeed expected theoretically from the highly relativistic empty-K-shell level. A fine-step yield curve straddeling the threshold was also measured to allow determination of the threshold and any shake-up component , if present.

We have also measured the Fe $K^h\alpha_{1,2}$ hypersatellite spectrum , which is given in figure (a) . This shows the expected two line structure, where, unlike in the diagram $K\ \alpha_{1,2}$ spectrum the α_2 line is about 10-fold stronger than the α_1 line, which is forbidden in LS coupling and appears here only because of the intermediate coupling in this atomic number range. The data is now being analyzed to obtain the line strength ratio, separation, widths and position. In addition, Dirac-Fock calculations will be done, and a full spectrum fit will be attempted, to obtain information on the intermediate coupling parameter, Breit-Wigner interaction etc.

In addition to the curve shown in figure (a), which was measured high above threshold, emission curves were also measured about 30 eV above threshold. This data is presently being compared to the saturation limit one to detect possible variations in the spectrum, as was found in our previous measurements on conventional satellites of Cu. The much lower cross-section near threshold, and the consequently lower statistics of the near-threshold data, require much care in such comparisons.

Finally, we have also measured the yield at the α_2 peak's position to obtain the line strength variation with incident energy. Again, a shake-off character is found with the curve rising smoothly from zero without any jumps at threshold. A fine-step curve was also measured which allowing an accurate determination of the threshold of the line.

In future measurements we will obtain similar data for other 3d-transition elements to elucidate the variation of the coupling parameter, Breit-Wigner interaction, intra-K-shell correlations etc. with the atomic number in the important region of the transition metals, where the coupling changes from an almost pure LS to a strongly intermediate one.